
I-40 CORRIDOR PROFILE STUDY

I-17 TO ARIZONA/NEW MEXICO BORDER

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Working Paper 3: Corridor Performance Goals and Objectives

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PREPARED FOR:

Arizona Department of Transportation



PREPARED BY:



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LIST OF ABBREVIATIONS

Abbreviation	Name
ADOT	Arizona Department of Transportation
AZTDM2	Arizona Travel Demand Model Version 2
BqAZ	Building a Quality Arizona
I	Interstate
MP	milepost
SR	State Route

1. INTRODUCTION

The Arizona Department of Transportation (ADOT) is the lead agency for this corridor profile study of Interstate 40 (I-40) East between I-17 in Flagstaff and the New Mexico state line. This study will look at key performance measures relative to the I-40 corridor, and use those as a means to prioritize future improvements in areas that show critical needs. The intent of the corridor profile program, and of the Planning to Programming process, is to conduct performance-based planning to identify areas of need and make the most efficient use of available funding to provide an efficient transportation network. ADOT is conducting eleven corridor profile studies. The eleven corridors are being evaluated within three separate groupings.

The first three studies (Round 1) began in spring 2014, and encompass:

- I-17: SR 101L to I-40
- I-19: Mexico International Border to I-10
- I-40: California State Line to I-17

The second round (Round 2) of studies, initiated in spring 2015, includes:

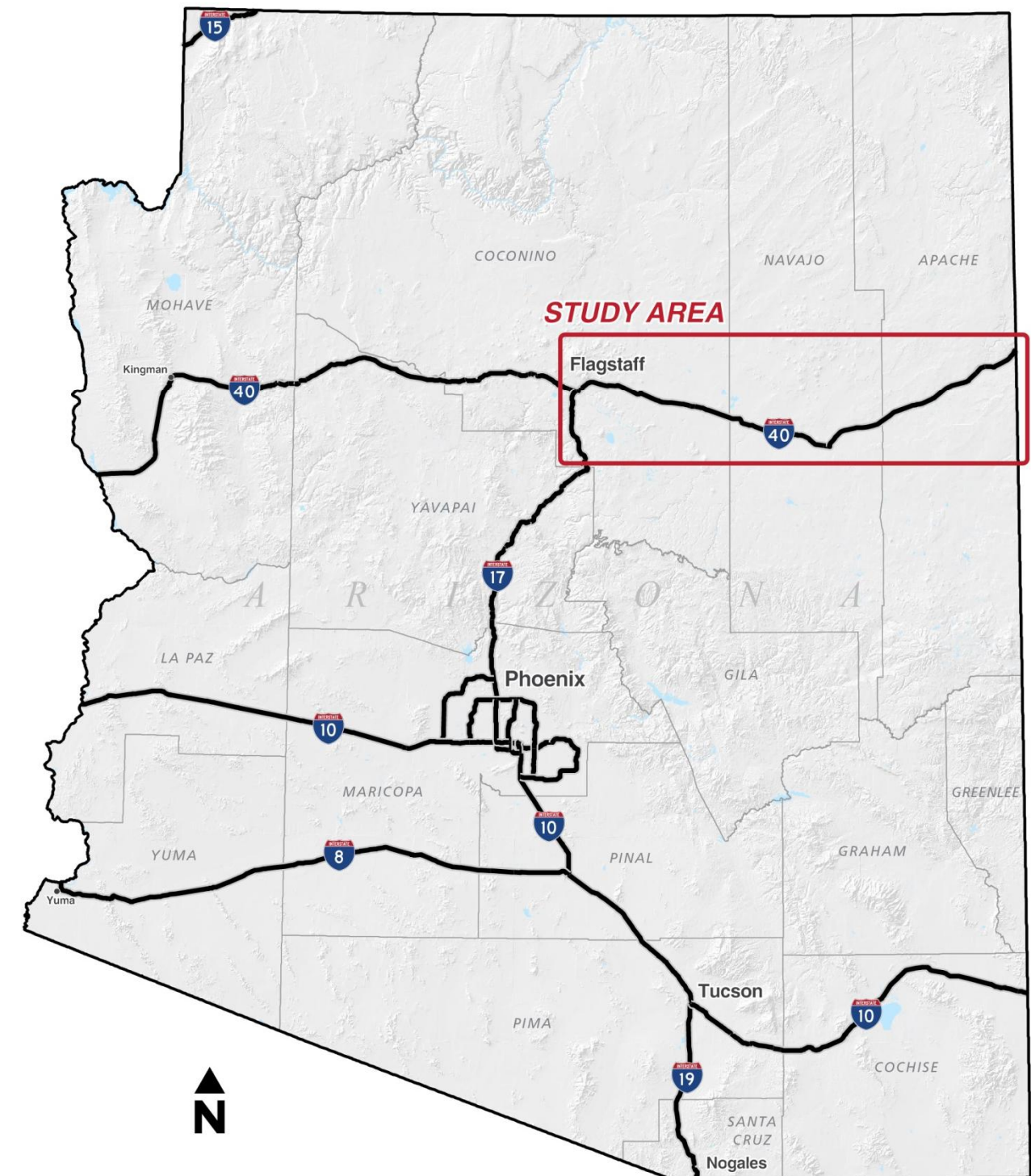
- I-8: California State Line to I-10
- I-40: I-17 to the New Mexico State Line
- SR 95: I-8 to I-40

The third round (Round 3) of studies, to be initiated in Fall 2015, include:

- I-10: California State Line to SR 85 and SR 85: I-10 to I-8
- I-10: SR 202L to the New Mexico State Line
- SR 87/SR 260/SR 377: SR 202L to I-40
- US 60/US 70: SR 79 to US 191 and US 191: US 70 to SR 80
- US 60/US 93: Nevada State Line to SR 303L

I-40, I-17 to New Mexico State Line, depicted in **Figure 1**, is one of the strategic statewide corridors and the subject of this Corridor Profile Study (**Round 2**).

Figure 1: Corridor Study Area



1.1 Corridor Study Purpose

ADOT has instituted a new corridor planning approach to develop strategies and tools that incorporate life-cycle cost analysis and risk assessment to measure system performance. This Corridor Profile Study will follow the new process established by previous corridor profile studies for I-17, I-19 and I-40, to:

- Inventory past improvement recommendations.
- Assess the existing performance based on quantifiable performance measures.
- Propose various solutions to improve corridor performance.
- Identify specific projects that can provide quantifiable benefits in relation to the performance measures.

1.2 Corridor Study Goals and Objectives

The objective of this study is to identify a recommended set of potential projects for consideration in future construction programs, derived from a transparent, defensible, logical, and replicable process. The I-40 Corridor Profile Study will define solutions and improvements for I-40 that can be evaluated and ranked to determine which investments offer the greatest benefit to the corridor in terms of enhancing performance.

The following goals have been identified as the outcome of this study:

- Link project decision-making and investments on key corridors to strategic goals
- Match solutions with deficiencies in measured performance
- Prioritize improvements that cost-effectively preserve, modernize, and expand transportation infrastructure

1.3 Working Paper 3 Overview

The purpose of Working Paper # 3 is to establish the existing national, regional, and local context of the I-40 corridor, summarize the results of the corridor performance, and develop goals, emphasis areas, and objectives for the future of this corridor.

The framework is based upon the five performance areas used to characterize the health of the I-40 corridor: pavement, bridge, mobility, safety, and freight. The product of Working Paper #3 is the development of performance goals and objectives for I-40 against which baseline performance can be evaluated. Differences between baseline performance and performance goals and objectives provide the framework for defining corridor needs in the investment areas of preservation, modernization, and expansion.

1.4 Corridor Overview

The I-40 corridor is a major east-west transcontinental interstate highway that connects the east coast (North Carolina) to the west coast (California). I-40 is a major transportation artery route for freight as well as passenger vehicular traffic, connecting major metropolitan cities in the south-western United States. I-40 is also the primary transportation route connecting the Phoenix metropolitan area to central and north-eastern parts of the country. I-40, together with I-17, plays a key role in the transportation infrastructure of northern Arizona, contributing to its economic success.

I-40 provides the most direct and fastest link between Flagstaff (and Grand Canyon National Park), central and north-eastern United States to the east, and major Californian Cities to the west (Figure 1). I-40 provides a principal road link for freight traffic from the ports in California. This study builds on earlier planning efforts in developing and applying a performance-based process for prioritizing improvements to meet present and future needs in the corridor.

1.5 Study Location and Corridor Segments

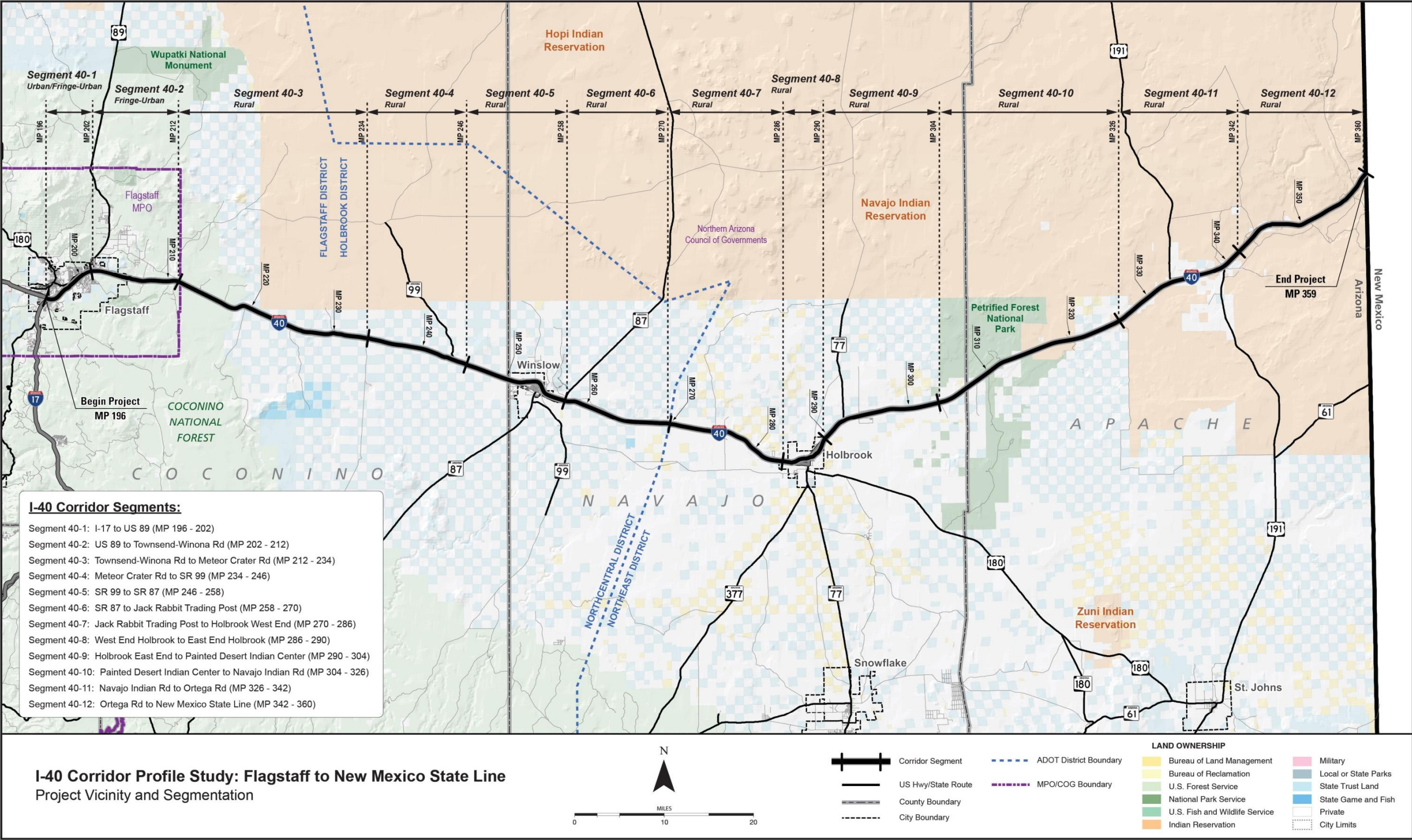
The I-40 corridor is being studied in two separate Corridor Profile Studies. One study extends from California to I-17 and this study extends from I-17 to New Mexico. For the purposes of this Corridor Profile Study, the portion from I-17 to New Mexico will be referred to as I-40 East.

The I-40 East corridor is 164 miles long, from I-17 (MP 196.0) to Arizona/New Mexico State Line (MP 359.0). The corridor has been divided into 12 distinct segments based on regionally significant intersecting routes, changes in topography, or natural or man-made landmarks along the corridor. The shortest segment is four miles long and the longest, a little over twenty-two miles. Corridor Segments have been described in **Table 1** below, and shown on a map in **Figure 2**.

Table 1: Corridor Segments and Descriptions

Corridor Segments							
Seg #	Begin/End Description	Begin MP	End MP	Length	Thru Lanes	AADT	Description
40-1	I-17 to US 89	196	202	6	4	37,684	This segment is generally urban/fringe-urban in nature, includes three interchanges, and is within the urbanized limits of the Flagstaff Metropolitan Area in Coconino County.
40-2	US 89 to Townsend-Winona Road	202	212	10	4	19,257	This segment is urban-fringe in nature, includes three interchanges, and is within Coconino County.
40-3	Townsend-Winona Road to Meteor Crater Road	212	234	22	4	15,468	This segment is generally rural in nature, includes four interchanges, and is within Coconino County.
40-4	Meteor Crater Road to SR 99	234	246	12	4	15,067	This segment is rural in nature, includes two interchanges, and within Coconino County.
40-5	SR 99 to SR 87	246	258	12	4	15,422	This segment is rural in nature, includes four interchanges, and spans Coconino and Navajo Counties. This segment passes through Winslow.
40-6	SR 87 to Jack Rabbit Trading Post	258	270	12	4	14,604	This segment is rural in nature, includes two interchanges, and is located within Navajo County.
40-7	Jack Rabbit Trading Post to Holbrook West End	270	286	16	4	14,916	This segment is rural in nature, includes four interchanges, and is located within Navajo County.
40-8	Holbrook West End to Holbrook East End	286	290	4	4	14,124	This segment is rural in nature, includes three interchanges, and is located within Navajo County. This segment passes through Holbrook.
40-9	Holbrook East End to Painted Desert Indian Center	290	304	14	4	16,674	This segment is rural in nature, includes four interchanges, and is located within Navajo County.
40-10	Painted Desert Indian Center to Navajo Indian Road	304	326	22	4	15,519	This segment is rural in nature, includes three interchanges, and spans Navajo and Apache Counties.
40-11	Navajo Indian Road to Ortega Road	326	342	16	4	14,719	This segment is rural in nature, includes three interchanges, and is located within Apache County.
40-12	Ortega Road to New Mexico State Line	342	359	18	4	15,580	This segment is rural in nature, includes seven interchanges, and is located within Apache County.

Figure 2: Study Area/Segmentation Map



2.0 CORRIDOR FUNCTIONALITY

This section provides an overview of how the corridor functions at the national and regional levels, as well as its relationship to local economies, major stakeholders, and multimodal opportunities.

2.1 National Context

The I-40 corridor is a major east-west transcontinental interstate highway that connects the west coast (California) to the east coast (North Carolina). It serves as a major artery for commercial trucks as well as passenger vehicular traffic. I-40, together with I-17, plays a key role in connecting central and northern Arizona to the rest of the country. It is a significant factor in the economic success of the region and the nation.

2.2 Regional Connectivity

I-40 East crosses the mostly rural and rolling terrain of northeastern Arizona. It provides the most direct and fastest link between Flagstaff (and Grand Canyon National Park), New Mexico, and Texas (Figure 1). I-40 East connects to southern California via the I-40 West segment west of Flagstaff, included in its own corridor profile study. The corridor offers a principal interstate highway link for freight traffic from the ports in California to the Southwest, eventually terminating on the East Coast in North Carolina.

I-40 East connects to I-17 in Flagstaff, the principal route from northern Arizona to the Phoenix metropolitan area. Other major north-south highways crossing the corridor include SR 87, SR 77, and US 191.

Total traffic volumes (AADT 2013) are approximately 15,000 to 19,000 throughout the length of the corridor, with the exception of the Flagstaff metropolitan area where daily volumes approach 40,000. The Arizona Travel Demand Model (AZTDM2) projects that traffic will more than double by 2035.

2.3 Commercial Truck Traffic

Arizona is primarily a pass-through state for freight traffic coming from the ports of Los Angeles and Long Beach and going east to the central U.S. for distribution. ADOT conducted an extensive stakeholder outreach program during the Arizona Multimodal Freight Analysis Study. One of the primary concerns raised by stakeholders was the increasing volume of through trucks traveling from southern California through Flagstaff and other northern Arizona communities. Federal safety regulations that restrict the time truck drivers can operate without a rest period force them to stop and park when they time out. As a result, an increasing number of trucks park along highways and in neighborhoods throughout communities in northern Arizona and elsewhere. The traffic mix includes significant commercial truck traffic, about 30% of the total volume. ADOT operates a Port of Entry at Sanders, near the New Mexico State Line.

The U.S. Department of Transportation, under Section 167(c) of title 23 United States Code (U.S.C.), created by Section 1115 of the Moving Ahead for Progress in the 21st Century Act (MAP-21), is directed to establish a National Freight Network (NFN) to assist States in strategically directing resources toward improved system performance for efficient movement of freight on the highway portion of the Nation's freight transportation system. I-40 has been designated by ADOT as part of the National Primary Freight Network.

2.4 Commuter Traffic

Significant commuter traffic is present on I-40 East in the Flagstaff area, especially west of the intersection with US 89 in corridor segment 40-1. Traffic forecasts indicate that this segment will become severely congested by 2035 without capacity increases and other modifications to the current four-lane section. Other population centers along the corridor, including Holbrook and Winslow, experience intra-city commuter traffic on the I-40 East to a much lesser degree.

Arizona Public Service (APS), a major utility company in the state, operates a large power station in Joseph City, located in segment 40-7. This major employment generator attracts commuter traffic to and from both directions on the corridor.

2.5 Recreation and Tourism

Arizona offers a variety of recreational opportunities for its citizens as well as the millions of visitors that travel to the state in search of warmer weather, outdoor adventure, and exploration opportunities. Arizona's warm weather and natural beauty makes tourism one of the state's top industries. According to the Arizona Office of Tourism, in 2013, 33.8 million people visited Arizona who collectively spent \$19.8 billion in the state, which supports jobs and generates tax revenue.

Recreation and tourism is a key industry along the corridor, especially in the Flagstaff area. US 89 serves as the principal gateway to the Grand Canyon National Park, one of the most visited sites in the country, with over 4.7 million visitors last year. Other outdoor recreation opportunities include many sites in the Cococino National Forest and the Riordan Mansion State Historic Park near Flagstaff as well as Petrified Forest National Park, Painted Desert National Monument, and Homolovi State Park near Holbrook.

2.6 Multimodal Uses

2.6.1 Freight Rail

The BNSF Transcon Corridor includes 390 route miles of double-track in Arizona connecting the Port of Los Angeles/Port of Long Beach with Chicago. The Transcon Corridor handles two-thirds of BNSF's intermodal container or trailer on flat car traffic nationally. The Transcon parallels I-40 the entire length of the corridor. Approximately 100 trains per day cross Arizona on the mainline, with nearly 300,000 carloads annually.

The Transcon provides transfer opportunities to the tourist rail service of the Grand Canyon Railway in Flagstaff. At-grade rail crossings through downtown Flagstaff lead to vehicular traffic congestion, although improvements are in progress. A short line operated by the BNSF Coronado & Springerville Subdivision intersects the main line near Coronado Junction and the Apache Railway intersects the main line near Holbrook. *(rail information sourced from Arizona State Rail Plan, ADOT, March 2011)*

2.6.2 Passenger Rail

Amtrak's Southwest Chief Chicago to Los Angeles route primarily serves long-distance tourist travel, with daily service. The Southwest Chief shares track on the BNSF Transcon and is subject to delays caused by freight traffic. It travels at an average speed of 63 m.p.h. across the State. Passenger stations are available in Gallup (New Mexico), Winslow, and Flagstaff.

2.6.3 Bicycles

Interstate shoulders built to design standards averaging 8-10 feet in width to accommodate cyclists on I-40 East.

2.6.4 Bus

Greyhound operates intercity bus transit the length of the I-40 Corridor connecting Gallup, NM to Flagstaff, Kingman, and Las Vegas, with stops in Holbrook and Flagstaff. Local transit service by Mountain Line operates eight routes in Flagstaff.

2.6.5 Aviation

A number of airports are located with proximity to the I-40 East corridor. These include the Flagstaff Pulliam Airport in Flagstaff, the Winslow-Lindbergh Regional Airport in Winslow, and the Holbrook Municipal Airport. The Pine Springs Airport is a historical airport located north of Seligman in Apache County.

2.7 Traveler Amenities

ADOT operates two rest areas along the I-40 East Corridor available for both commercial and non-commercial vehicles. Meteor Crater Rest Area near Winslow is located near scenic rock formations on the north side of I-40 about 17 miles west of Winslow. The Painted Cliffs Rest Area and Welcome Center is located at Exit #359 near Lupton and the Arizona/New Mexico State Line.

Dynamic Message Signs (DMS's) provide various types of information to travelers in real time. ADOT operates DMS's at the following locations on the I-40 East corridor:

- Eastbound and Westbound in the Flagstaff Area between I-17 and US-89
- Westbound near the Winona crossroad
- Eastbound and Westbound west of Winslow
- Westbound east of Winslow
- Eastbound west of Holbrook
- Westbound east of Holbrook
- Eastbound near the Painted Desert crossroad
- Eastbound west of Chambers
- Westbound east of Sanders
- Westbound east of Lupton, near the New Mexico border

2.8 Land Ownership, Land Uses, and Jurisdictions

As shown in Figure 2, I-40 East crosses multiple jurisdictions and land holdings throughout Coconino, Navajo, and Apache Counties. A majority of the land surrounding I-40 East in segments 40-1 and 40-2 is encompassed on the Coconino National Forest, owned by the U.S. Forest Service. A majority of the land both north and south of I-40 in segments 40-3 through 40-9 is a checkerboard of private and state trust land. Portions of that checkerboard in segments 40-7 through 40-9 include land ownership by the Bureau of Land Management. The portion of segment 40-10 that borders the Petrified Forest National Park is owned by the National Park Service. Beginning east of Petrified Forest National park and extending to the New Mexico border, the majority of the land surrounding I-40 is owned by the Navajo Nation. The Hopi and Zuni Indian Reservations are both in proximity to the corridor, but not immediately adjacent to I-40.

2.8.1 Population Centers

The I-40 East Corridor, through three counties, is mostly rural. The only major population center, Flagstaff, with a current population of 69,000 is the western end of the corridor. Significant growth is projected to continue in the Flagstaff metropolitan area. Winslow and Holbrook, the other larger towns on the corridor have current populations of 9,700 and 5,200 respectively. Table 2 shows current (2014) population by county and city along with projected future (2040) population and growth.

Table 2: Current and Future Population

Current and Future Population					
Area	2010	2014	Projected 2040	% Change 2010-2040	Total Growth
Coconino County	134,421	136,636	161,346	20.0%	26,925
Flagstaff	65,870	68,140	87,735	33.2%	21,865
Fredonia	1,314	1,307	1,307	-0.5%	-7
Page	7,247	7,433	8,334	15.0%	1,087
Sedona (part)	2,842	2,838	3,336	17.4%	494
Tusayan	558	550	550	-1.4%	-8
Williams	3,023	3,009	3,152	4.3%	129
Unincorporated	53,567	53,358	56,933	6.3%	3,366
Navajo County	107,449	110,142	132,276	23.1%	24,827
Holbrook	5,053	5,142	6,175	22.2%	1,122
Pinetop-Lakeside	4,282	4,465	5,966	39.3%	1,684
Show Low	10,660	11,389	17,375	63.0%	6,715
Snowflake	5,590	5,893	8,380	49.9%	2,790
Taylor	4,112	4,360	6,400	55.6%	2,288
Winslow	9,655	9,636	10,217	5.8%	562
Unincorporated	68,097	69,259	77,763	14.2%	9,666
Apache County	71,518	72,501	69,176	-3.3%	-2,342
Eager	4,885	5,059	6,251	28.0%	1,366
Saint Johns	3,480	3,659	4,684	34.6%	1,204
Springerville	1,961	2,030	2,511	28.0%	550
Unincorporated	61,192	61,752	55,730	-8.9%	-5,462

Source: Census, Arizona Department of Administration – Employment and Population Statistics

2.8.2 Major Traffic Generators

Much of the traffic on I-40 East results from interstate commercial and long distance personal travel. The City of Flagstaff and Grand Canyon National Park generate high volumes of traffic locally. Flagstaff serves as the principal gateway to the Park, accessed primarily by US 89 and SR 64 to the popular South Rim area. The Petrified Forest National Park and Painted Desert are also popular attractions along the corridor, but do not generate as much traffic.

The Joseph City Power Station, operated by APS, constitutes a major employment traffic generator for commuter traffic. The power station is located near Joseph City, between Winslow and Holbrook in segment 40-7. The power station attracts commuter traffic from both directions on the corridor.

2.8.3 Tribes

The Navajo Nation is a semi-autonomous Native American-governed territory covering 27,425 square miles, occupying portions of northeastern Arizona, southeastern Utah, and northwestern New Mexico in the United States. It is the largest land area retained by a U.S. tribe and is managed via agreements with the United States Congress as a sovereign Native-American nation. Over 180,000 people live on the Navajo Reservation across three states: Arizona, New Mexico, and Utah.

The Navajo Nation is one of the largest tribal governments of the North American Indian tribes. Its institutions include a judicial system, a legislative house, an executive office, a prominent law enforcement and social services apparatus, Health Services, Diné College, and other local educational trusts. (Source: https://en.wikipedia.org/wiki/Navajo_Nation)

2.9 Wildlife Consideration

The Arizona Game and Fish Department published the Arizona State Wildlife Action Plan (SWAP) in 2010. This SWAP provides a 10-year vision for achievement, subject to adaptive management and improvement along the way. The plan covers the entire state, identifying wildlife and habitats in need of conservation, insight regarding the stressors to those resources, and suggests actions that can be taken to alleviate those stressors.

Using the Habimap Tool that creates an interactive database of the information included in the SWAP, the following were identified in relation to the I-40 East corridor:

- Wildlife waters to the south of I-40 between I-17 and Twin Arrows Road
- I-40 travels through U.S. Forest Service allotments from I-17 to approximately Twin Arrows Road, and through Arizona State Land Department allotments from Twin Arrows Road to just west of Chambers.
- Arizona Wildlife Linkages potential zones exist along I-40 between I-17 and approximately Navajo Road. Habitat fracture zones are identified intermittently from Flagstaff to Twin Arrows Road, and intermittently from the Apache/Navajo County border to the New Mexico border.
- Species and Habitat Conservation Guide indicates sensitive species southeast and northwest of Flagstaff throughout the National Forest, and along the Little Colorado River between Winslow and Holbrook.
- Species of Greatest Conservation need are identified continuously along the corridor between I-17 and the Painted Desert area, and intermittently between the Painted Desert and New Mexico border. Highest concentrations are located near Flagstaff.

- A high level of Species of Economic and Recreational Importance are identified southeast of Flagstaff. A low level is identified throughout the corridor from I-17 to the Painted Desert area.

A recent report on Elk movements completed by Arizona Game and Fish Department identified the area roughly corresponding to segments 40-1 and 40-2 as high priority for elk crossings. The research recommended 8 wildlife passage structures between MP 195 and MP 215: 2 existing structures, 1 new overpass, and 5 new underpasses.

2.10 Other Corridor Assets

Corridor transportation assets are summarized in **Figure 3**.

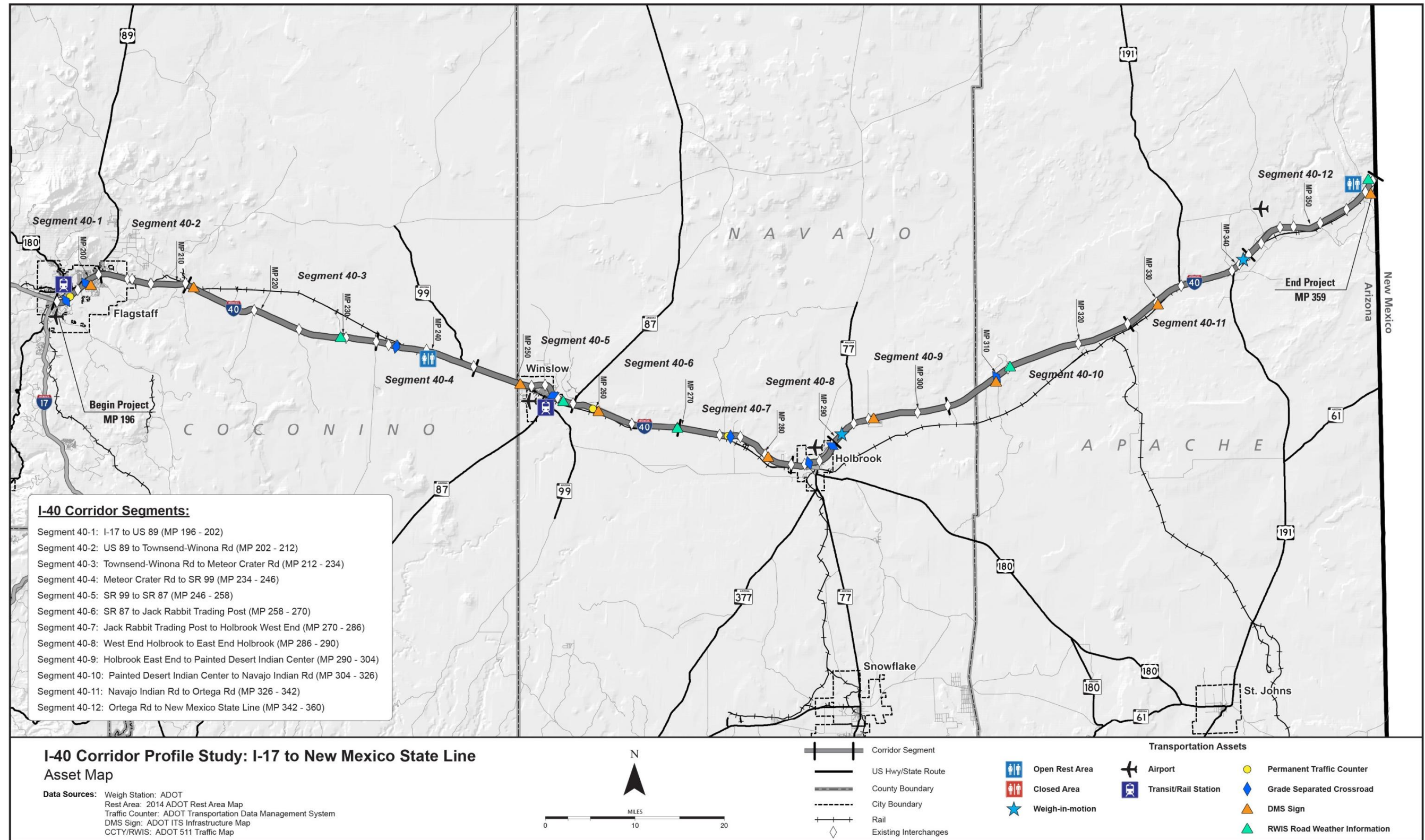
A freight weigh station is located near the New Mexico Border in Sanders, Arizona. There are 7 grade separated road crossings on the corridor. Two are located in Flagstaff, one in Winslow, one

in Joseph City, two in Holbrook, and one at the Petrified Forest National Park. In addition, there is one grade-separated railroad crossing of the BNSF Railroad in segment 40-4, west of the Meteor Crater rest area. There are three permanent traffic counters located along the I-40 East corridor.

2.11 Conclusion of Corridor Characteristics

The I-40 East Corridor serves a major role for interstate commercial and passenger trips. Most of the corridor is sparsely populated and contributes little to total volumes. The corridor is identified by ADOT as a Strategic Corridor, connecting California to points across the southwestern United States. Along with I-10, the corridor is a cornerstone in the State's economy. Flagstaff, the largest city, is a small, growing metropolitan area with significant traffic volumes for the current four-lane cross-section. I-40 connects to I-17 in Flagstaff, which accesses the central and southern urban zones of the state.

Figure 3: I-40 East Corridor Transportation Assets



3.0 SUMMARY OF CORRIDOR PERFORMANCE

A system to establish baseline corridor performance was developed through a collaborative process with ADOT, the Technical Advisory Committee (TAC) and the Corridor Teams for the profile studies. Baseline performance was evaluated using primary and secondary performance measures to define the corridor health. Corridor needs constitute the difference in baseline corridor performance compared to performance objectives.

The performance system consists of five areas: Pavement, Bridge, Mobility, Safety, and Freight. For each of these performance areas, a primary measure – known as the Index – was defined along with a set of secondary measures that allows for a more detailed analysis of corridor performance. **Table 3** lists the primary and secondary measures that were evaluated for each of the five performance areas.

Working Paper 2 evaluated the overall corridor performance (as a weighted average by segment length) and individual segment performance in the five aforementioned areas. The primary and secondary performance measures were quantified where feasible. A scale for each measure was developed based on adopted ADOT thresholds, where applicable, or on statistical analysis of statewide datasets. The scaling is split into three levels, each of which is represented by a corresponding color. The scale levels are named “good” (green), “fair” (yellow), and “poor” (red), except that for measures based on a comparison to statewide averages (e.g., the Safety performance area) where the levels are called “above average” (green), “average” (yellow), and “below average” (red). Some of the secondary measures are “hot spots” that cannot be readily quantified at a segment or overall corridor level, so no scaling was developed for “hot spots”.

Good / Above Average Performance
Fair / Average Performance
Poor / Below Average Performance

The corridor weighted average ratings are summarized in **Figure 4**, which also provides a brief description of each performance measure. **Figure 5** shows the corridor and segment performance for each primary measure. The following sub-sections summarize the measured performance in each performance area according to the analysis findings documented in Working Paper 2.

Table 3: Performance Index, Primary Measures, Secondary Measures

Performance Area	Primary Measure	Secondary Measures
Pavement	Pavement Index (based on a combination of International Roughness Index and Cracking)	<ul style="list-style-type: none"> Directional Pavement Serviceability Pavement Area Failure Pavement Hot Spots
Bridge	Bridge Index (based on Deck Rating, Substructure Rating, or Superstructure Rating)	<ul style="list-style-type: none"> Bridge Sufficiency Rating Functionally Obsolete Lowest Bridge Rating Bridge Hot Spots
Mobility	Mobility Index (based on combination of Current V/C and Future V/C)	<ul style="list-style-type: none"> Existing Directional Peak Hour Volume/Capacity Future Volume/Capacity Directional Travel Time Index Directional Planning Time Index Road Closure Frequency Percent Non-SOV Trips Bicycle Accommodation
Safety	Safety Index (based on frequency of fatal and incapacitating injury crashes)	<ul style="list-style-type: none"> Percent Strategic Highway Safety Plan Emphasis Areas Crash Unit Types Directional Safety Index Safety Hot Spots
Freight	Freight Index (based on Truck Planning Time Index)	<ul style="list-style-type: none"> Directional Truck Travel Time Index Directional Truck Planning Time Index Road Closure Duration Clearance Restrictions

Figure 4: I-40 East Corridor Performance Summary

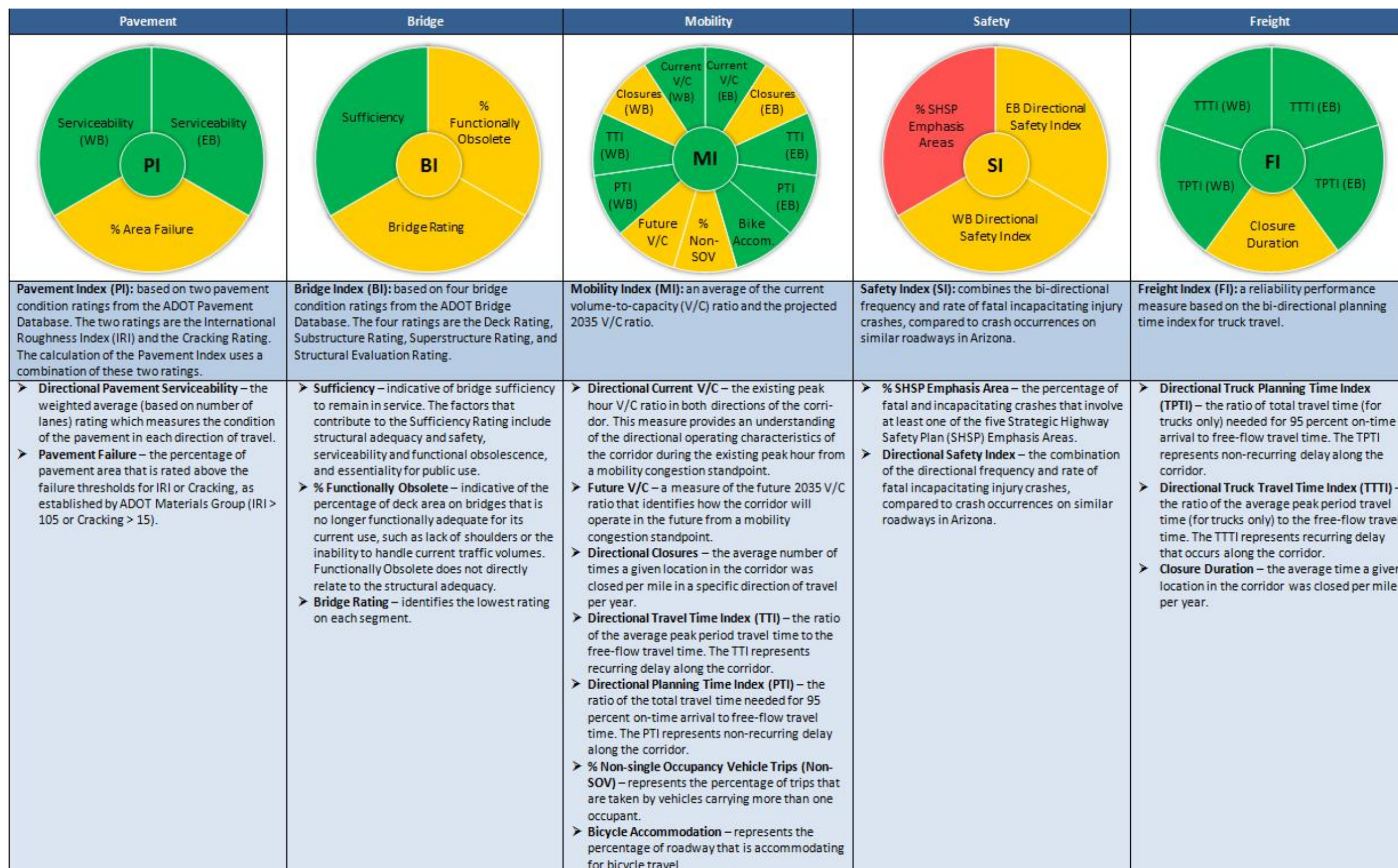
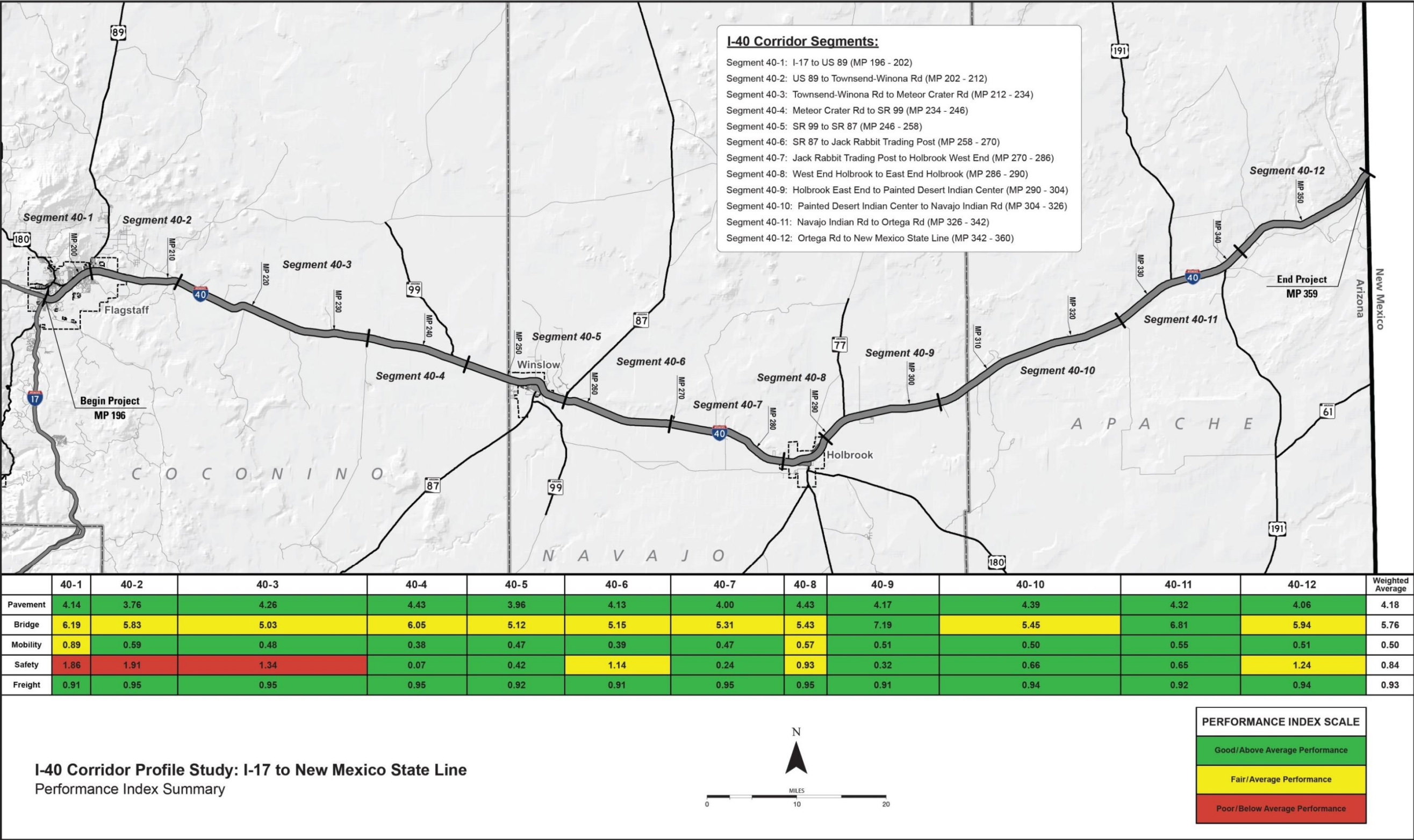


Figure 5: I-40 East Corridor Performance Index Summary Map



3.1 Pavement

Based on the weighted average of the Pavement Index, the pavement on the corridor is in “good” condition. Overall, according to the Pavement Index, nearly all sections of the pavement are in “good” condition.

There are several failure hot spots along the corridor in segments 2, 3, 7, 9, and 12, including 7 miles on eastbound I-40 and 4 miles on westbound I-40. These hot spots were identified using methods described in Working Paper 2. 30% of the pavement in segment 2 is in “poor” condition. The eastbound and westbound pavements are nearly equal in condition, with the exception of a “fair” pavement PSR in eastbound segment 2. Segment 2 has the lowest Pavement Index, the lowest PSR in both directions, and the highest percentage of pavement in “poor” condition.

3.2 Bridge

Overall, based on the weighted average of the Bridge Index, the bridges on the corridor are in “fair” condition. Additionally according to the Bridge Index, nearly all of the individual bridges are in “fair” condition.

There are sixteen structurally deficient bridges along the corridor, which are located in segments 3, 5, 7, 8, 10, and 12. There also sixteen bridges with a multiple rating of 5 along the corridor, which are located in segments 1, 3, 5, 6, 7, 10, and 12.

There is one bridge – the Painted Desert TI underpass, located in segment 10 – with a sufficiency rating of “poor.” There are a high number of functionally obsolete bridges in segments 2, 6, 8, 9, 10, 11, and 12. Segments 3, 5, and 6 have the lowest Bridge Indices. These bridges and those with structural deficiency are described in more detail in Working Paper 2.

3.3 Mobility

A thorough analysis of mobility on the corridor is described in Working Paper 2. Based on the overall weighted average of the Mobility Index, the traffic operations on the corridor are in “good” condition. The existing peak hour traffic operations are “good,” as well. The future traffic operations are anticipated to perform “poor” in two of the twelve segments – segments 1 and 8. Not only do segments 1 and 8 perform the worst in the Future V/C performance measure, but they also have the highest Mobility Indices.

A majority of the segments show “fair” performance in the Closure performance measure. Segment 4 has the highest number of closures. The Travel Time Index (TTI) and Planning Time Index (PTI) measures generally show “fair” or “good” along the corridor. The PTI measure shows a “good” performance for all segments, indicating that the I-40 corridor has a very reliable travel time.

A majority of the corridor displays “poor” or “fair” performance for non-SOV trips, meaning that many vehicles on the corridor carry only a single occupant. All of the segments show a “good” performance for accommodation of bicycles.

3.4 Safety

The weighted average of the Safety Index for the corridor as a whole shows an “average performance” condition. Half of the segments perform above average and the remaining six are split between “average performance” and “below average performance” in the Safety Index.

Segments 1 and 2 perform below average in the Safety Index, the top 5 SHSP emphasis areas, and both directions of travel in the Safety Index. There are several locations of high crash frequency, including eastbound in segments 1, 2, 3, and 12, and westbound in segments 1, 2, and 8. These locations are identified using methodologies described in Working Paper 2. Eight of the twelve segments performed below average in the percentage of crashes involving one of the SHSP Top 5 Emphasis Area Behaviors.

3.5 Freight

The overall weighted average of the Freight Index shows that the corridor is in “good” condition. In addition, all of the segments individually show “good” performance in the Freight Index, directional TTI and directional PTI.

Based on results found in Working Paper 2, a majority of the segments show “fair” performance in the closure performance measure. Segments 3, 4, 5, 10, and 11 have the longest durations of closures. There is one location along the corridor – the westbound Cosnino Road TI – that has a vertical clearance restriction that cannot be by-passed by using ramps.

4.0 CORRIDOR PERFORMANCE GOALS AND OBJECTIVES

The I-40 East Corridor from I-40 to the New Mexico State Line is and will continue to be a major transportation corridor for interstate and intrastate commerce, intercity travel and tourism. ADOT has designated this section of I-40 as a Strategic Corridor and as part of the National Primary Freight Network. The performance goals for the I-40 East corridor include the following key points:

- Meet goals and vision of Long-Range Transportation Plan and bqAZ
- Enhance safety
- Maintain and preserve highway infrastructure
- Provide reliable route for tourist travel
- Provide efficient commuting route within the Flagstaff metropolitan area
- Provide reliable route for interstate and intrastate freight traffic
- Provide efficient commuting route to/from APS power station at Joseph City

Statewide goals and performance measures were established by the ADOT *Long-Range Transportation Plan* (LRTP), 2010-2035. Statewide performance goals that are relevant to the I-40 East performance framework areas were identified and corridor objectives were then formulated for each of the five performance framework areas that aligned with the overall statewide goals established by the LRTP. **Table 4** shows the I-40 East corridor performance objectives and how they align with the statewide goals; the corridor objectives are also detailed below:

- Reduce current and future congestion
- Reduce delays from non-recurring events and incidents to enhance travel time reliability
- Reduce delays and restrictions to freight movements and improve travel time reliability
- Reduce the number of structurally deficient bridges
- Maintain acceptable level of pavement ride quality
- Reduce fatal and serious injury crashes

4.1 Stakeholder Input

The study team met with stakeholders at two separate meetings, one at the Northeast District and one at the Northcentral District (including the Flagstaff Metropolitan Planning organization – FMPO – and the Northern Arizona Council of Governments – NACOG). The meetings were held to discuss the results of the performance evaluation in Working Paper 2 as well as help develop the goals and objectives for the corridor. A summary of these meetings in regards to the goals and objectives is presented in the subsequent section. Feedback provided on the I-40 East performance evaluation was documented in Section 5.0 of the Working Paper 2.

Northeast District

The Northeast District meeting was held on October 5, 2015 and included participants from the ADOT Northeast District (formerly the Holbrook District), ADOT Multimodal Planning Division, and the consultant team. Comments from the meeting include the following:

- District staff felt that Safety, Bridge, and Pavement performance areas should be the corridor emphasis areas
- The prevalence of the use of I-40 as an intra-city local route within Holbrook and Winslow is minor, at least in comparison to its use within Flagstaff
- District staff indicated that I-40 is used as a commuter route to and from both directions for the largest employer in the area – the Joseph City APS Power Station

Northcentral District

The Northcentral District meeting was held on October 7, 2015, and included participants from the ADOT Northcentral District (formerly the Flagstaff District), the Flagstaff Metropolitan Planning Organization (FMPO), NACOG, ADOT Multimodal Planning Division, and the consultant team. Comments from the meeting include the following:

- District staff agreed that Safety, Bridge, and Pavement performance areas should be the corridor emphasis areas

4.2 Performance Emphasis Areas

Based on information from the ADOT Districts, MPOs, and COGs, the Pavement, Bridge and Safety Performance Areas were identified as critical performance areas for I-40 East. As such, the corridor objectives shown in Table 4 reflect an emphasis in these three performance areas.

4.3 Performance Objectives

Taking into account the corridor performance goals and identified “emphasis areas”, performance objectives were developed for each quantifiable performance measure that identify the desired level of performance based on the performance scale levels for the overall corridor and for each segment of the corridor. The performance objectives within each of the five performance areas are shown in Table 4.

The colors shown in Table 4 represent the corresponding level of performance as described earlier, with green indicating “good” or “above average” performance and yellow indicating “fair” or “average” performance, and red indicating “poor” performance. Good/above average performance is the desired level of performance for the overall corridor primary measure for performance areas designated as “emphasis areas”.

Table 4: Corridor Performance Goals and Objectives

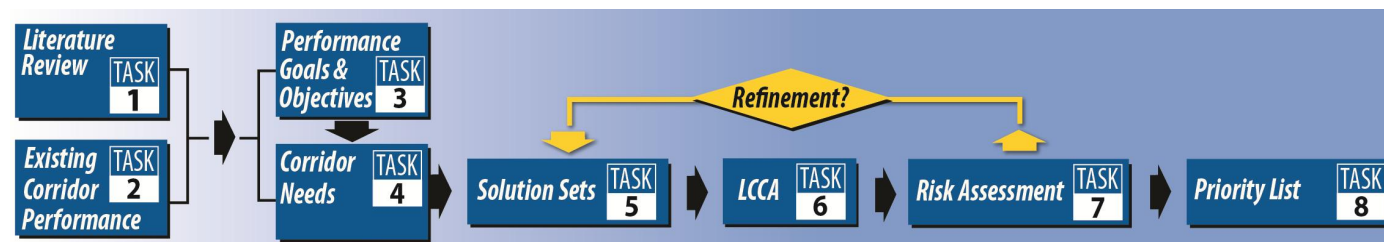
ADOT Statewide LRTP Goals	I-40 Corridor Goals	I-40 Corridor Objectives	Performance Area	Performance Measure	Performance Objective	
					Corridor Average	Segment
Improve Mobility and Accessibility Support Economic Growth	Provide reliable route for tourist travel	Reduce Current and Future Congestion	Mobility	Mobility Index	Fair or better	Fair or better
	Provide efficient community route within the Flagstaff metropolitan area	Reduce delays from non-recurring events and incidents to enhance travel time reliability		Existing Directional Peak Hour V/C		Fair or better
				Future V/C		Fair or better
				Directional Closure Frequency		Fair or better
				Directional Travel Time Index		Fair or better
				Directional Planning Time Index		Fair or better
				Percent Non-SOV Trips		Fair or better
	Provide efficient community route to/from APS power station at Joseph City			Percent Bicycle Accommodation		Fair or better
	Provide reliable route for interstate and intrastate freight traffic	Reduce delays and restrictions to freight movement and improve travel time reliability	Freight	Freight Index	Fair or better	Fair or better
				Directional Travel Time Index		Fair or better
				Directional Planning Time Index		Fair or better
				Closure Duration		Fair or better
Preserve and Maintain the State Transportation System	Maintain and preserve highway infrastructure	Reduce the number of structurally deficient bridges	Bridge (Emphasis Area)	Bridge Index	Good	Fair or better
				Bridge Sufficiency Rating		Fair or better
				Bridge Rating		Fair or better
				Percent Deck Area on Functionally Obsolete Bridges		Average or better
		Maintain acceptable level of pavement ride quality	Pavement (Emphasis Area)	Pavement Index	Good	Fair or better
				Directional Pavement Serviceability		Fair or better
				Percent Pavement Area Failure		Average or better
Enhance Safety and Security	Enhance safety	Reduce fatal and serious injury crashes	Safety (Emphasis Area)	Safety Index	Above Average	Average or better
				Percent SHSP Emphasis Areas		Average or better
				Directional Safety Index		Average or better

5.0 NEXT STEPS

The overall Corridor Profile Study process is shown in Figure 6. The process consists of eight tasks where the final results will provide candidate projects for P2P prioritization and inform the LRTP Update. The next step in the I-40 East Corridor Profile Study will be to conduct a needs assessment based on the relationship between the existing performance and desired performance (Task 4). The corridor team will compare measured performance completed in Task 2 to the Corridor Objectives and Goals identified in this Working Paper 3 (Task 3). A “need” is identified when measured performance does not meet the expected performance objective.

The next deliverable, Working Paper 4, will report the findings from a needs analysis to help identify strategic improvements. The needs analysis will take a detailed look at the available data sets for each of the primary and secondary performance measures (including the “hot spots”). Following the needs assessment, “solution sets” will be developed to address the identified needs and improve performance (Task 5).

Figure 6: Corridor Profile Study Process



- **Task 1** assesses work already completed in the corridor through a literature review
- **Task 2** determines existing corridor performance based on data collected for the identified performance areas (pavement, bridge, mobility, safety and freight)
- **Task 3** develops long-term goals and objectives that define how the corridor can be expected to function, its primary purpose and performance emphasis areas
- **Task 4** determines corridor needs by comparing existing conditions to expected performance
- **Task 5** formulates solutions to raise performance levels throughout the corridor with a focus on high need areas
- **Task 6** estimates the cost of solutions using life-cycle cost analysis (LCCA) and benefit cost analysis (BCA) approaches to ensure a full understanding of the long term costs to be managed
- **Task 7** performs a risk-based assessment to ensure that the solution set selected is the most effective at enhancing corridor performance. Where necessary, solution sets can be modified to maximize their performance contribution.
- **Task 8** describes the strategic projects comprising the solution set using a Project Scoping Template